

Claims

1 1. An apparatus for varying the optical transmission
2 intensity on a substrate wafer in a photolithography process
3 comprising:

4 a first polarizer capable of adjustment during the
5 optical transmission such that the contrast of an
6 optical image focused on said substrate wafer is
7 variable, said adjustment made relative to a second
8 polarizer; and,

9 a photo mask patterned with a plurality of optically
10 transparent and optically opaque regions, wherein said
11 transparent regions are impregnated with said second
12 polarizer, fixed in a predetermined direction, such
13 that said photo mask develops a diffraction pattern of
14 said optical image during optical transmission.

1 2. The apparatus of claim 1 further comprising:

2 a light source for optically transmitting an incident
3 electromagnetic radiation beam with a predetermined
4 frequency spectrum;

5 electromagnetic radiation beam focusing means for
6 concentrating said beam on said first polarizer; and,
7 electromagnetic radiation beam image reducing means to
8 reduce and focus said diffraction pattern on said
9 substrate wafer.

1 3. The apparatus of claim 1 wherein said photo mask
2 comprises:

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3 a patterned spin-on-glass layer for phase shifting said
4 transmitted electromagnetic radiation; and,
5 a patterned metal layer for blocking transmission of said
6 electromagnetic radiation.

1 4. The apparatus of claim 2 wherein said focusing means
2 and said image reducing means comprise a plurality of
3 optical lenses.

1 5. The apparatus of claim 2 wherein said first polarizer
2 rotates in a plane normal to the direction of said incident
3 electromagnetic radiation such that the direction of
4 electric vector components of said electromagnetic radiation
5 emerging from said first polarizer is adjustable over a
6 dynamic range encompassing a position parallel to said fixed
7 position of said second polarizer, to a position
8 perpendicular to said fixed position of said second
9 polarizer.

1 6. The apparatus of claim 3 wherein said photo mask opaque
2 layer comprises a metal layer of chromium, molybdenum,
3 aluminum, tungsten, or titanium.

1 7. An apparatus for varying the transmission intensity in
2 a photolithography process comprising:
3 a light source for optically transmitting an incident
4 electromagnetic radiation beam with a predetermined
5 frequency spectrum;

6 a first polarizer capable of adjustment during the
7 optical transmission such that the contrast of an
8 optical image focused on a substrate wafer is variable,
9 said adjustment made relative to a second polarizer;
10 focusing optics for concentrating said beam on said first
11 polarizer;
12 a photo mask patterned with a plurality of optically
13 transparent and optically opaque regions, wherein said
14 transparent regions are impregnated with said second
15 polarizer, fixed in a predetermined direction, such
16 that said photo mask develops a diffraction pattern of
17 said optical image during optical transmission; and,
18 reducing optics to reduce and focus said diffraction
19 pattern on said substrate wafer.

1 8. The apparatus of claim 7 further comprising a photo
2 mask with a phase shifting layer to enhance the contrast of
3 said diffraction pattern.

1 9. The apparatus of claim 7 wherein said optically opaque
2 region has an optical transmissivity level of 0.1%.

1 10. A method for forming a pattern on a substrate wafer in
2 a photolithography process comprising the steps of:
3 polarizing incident electromagnetic radiation with a
4 first polarizer;
5 providing a patterned photo mask with a plurality of
6 optically transparent and optically opaque regions,

7 wherein said transparent regions are impregnated with a
8 second polarizer, fixed in a predetermined direction;
9 rotating said first polarizer relative to said second
10 polarizer during transmission of said incident
11 electromagnetic radiation; and,
12 developing a diffraction pattern on said substrate such
13 that said diffraction pattern light intensity is
14 adjustable by said rotating said first polarizer.

1 11. The method of claim 10 further comprising the steps of:
2 providing a light source for optically transmitting said
3 incident electromagnetic radiation with a predetermined
4 frequency spectrum; and,
5 focusing said incident electromagnetic radiation for
6 concentrating on said first polarizer;

1 12. The method of claim 10, providing a patterned photo
2 mask, comprises:
3 providing a transparent substrate;
4 applying a silicon compound layer to said transparent
5 substrate using a spin-on-glass technique;
6 adding polarizable crystals of a colloidal size to said
7 silicon compound layer;
8 subjecting said transparent substrate with said polarized
9 crystals to a magnetic field sufficient to align said
10 crystals in a predetermined direction, before and
11 during a curing stage;
12 depositing an opaque metal layer;

13 adding a patterned photoresist over said metal layer;
 14 etching or cutting said metal layer; and
 15 removing said spin-on-glass layer to the pattern of said
 16 photoresist.

1 13. The method of claim 12, adding polarizable crystals,
 2 further comprises adding polarizable crystals at a
 3 concentration level of 2000 parts per million.

1 14. A method for forming a pattern on a substrate wafer in
 2 a photolithography process comprising the steps of:
 3 providing an incident electromagnetic radiation beam for
 4 beam transmission;
 5 focusing said beam;
 6 performing a first polarization of said beam such that
 7 said polarization is variable during said beam
 8 transmission;
 9 masking said beam with a photo mask patterned to develop
 10 an optical image;
 11 performing a second polarization of said beam during said
 12 beam transmission through said photo mask;
 13 reducing said optical image transmitted through said
 14 photo mask onto said substrate; and,
 15 adjusting the intensity of said beam by varying the
 16 direction of said first polarization with respect to
 17 said second polarization during said beam transmission.

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1 15. A method for forming a pattern on a substrate wafer in
2 a photolithography process comprising the steps of:
3 providing an incident electromagnetic radiation beam;
4 focusing said beam on an adjustable first polarizing
5 device;
6 polarizing said beam with said adjustable first
7 polarizing device;
8 masking said beam with a photo mask patterned to develop
9 an optical image;
10 polarizing said beam with a fixed second polarizing
11 device within said photo mask;
12 reducing said optical image transmitted through said
13 photo mask onto said substrate; and,
14 adjusting the intensity of said beam by varying the
15 direction of said adjustable first polarizing device
16 with respect to the direction of said fixed second
17 polarizing device.

1 16. The method of claim 15 wherein polarizing of said beam
2 with a fixed second polarizing device within said photo mask
3 further comprises phase-shifting said beam to further
4 enhance the contrast of said image.

